Longitudinal Double Spin Asymmetry using $p + p \rightarrow \pi^0 + X$ at PHENIX

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PHENIX

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My Focus

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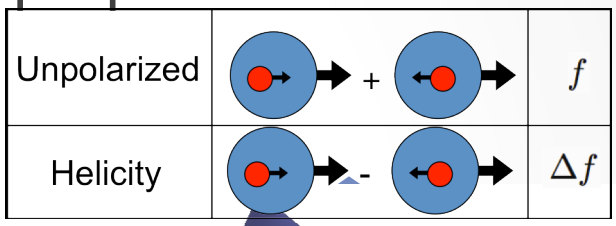
Spin Structure of the Nucleon

- Properties of the proton arise from properties of the constituents

$$S_p = \frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L_q + L_g$$



$\Delta\Sigma$ = quark spin contribution

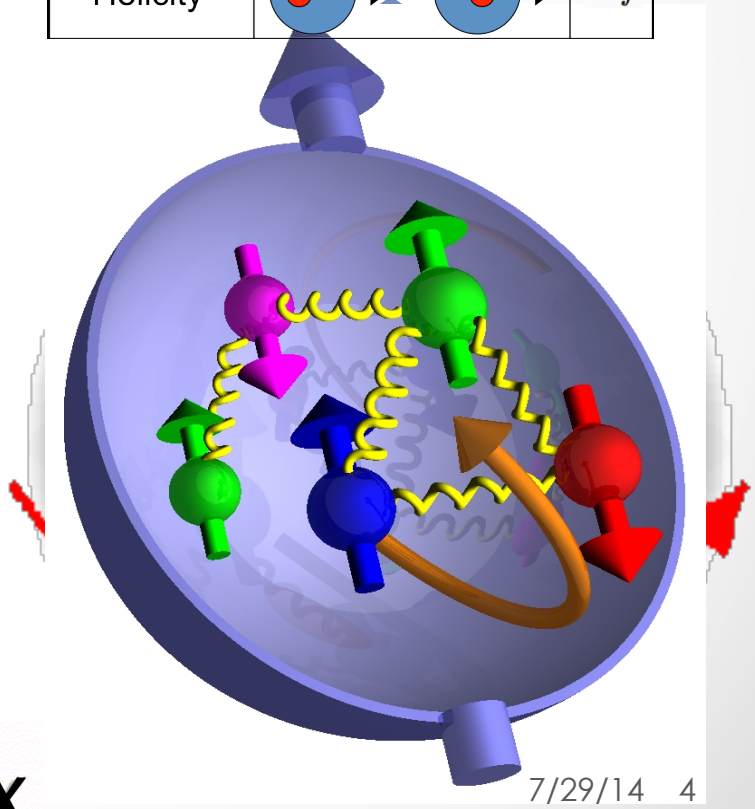
~0.3 from polarized DIS

ΔG = gluon spin contribution

poorly constrained in DIS due to minimal gluon sensitivity

L_q = quark Orbital Angular Momentum(qOAM)

L_g = gluon Orbital Angular Momentum(gOAM)



Accessing ΔG in p+p: A_{LL}

$$A_{LL} = \frac{\sigma_{++} - \sigma_{+-}}{\sigma_{++} + \sigma_{+-}} = \frac{\sum_{a,b,c=q,\bar{q},g} \Delta f_a \otimes \Delta f_b \otimes \Delta\hat{\sigma} \otimes D_{\pi/c}}{\sum_{a,b,c=q,\bar{q},g} f_a \otimes f_b \otimes \hat{\sigma} \otimes D_{\pi/c}}$$

From ep (&pp) (HERA mostly)

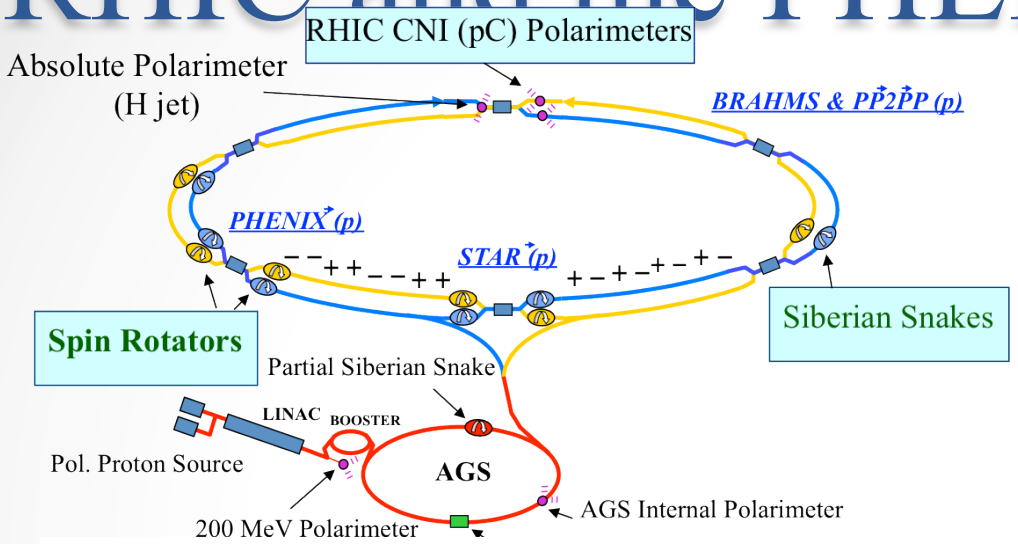
pQCD NLO

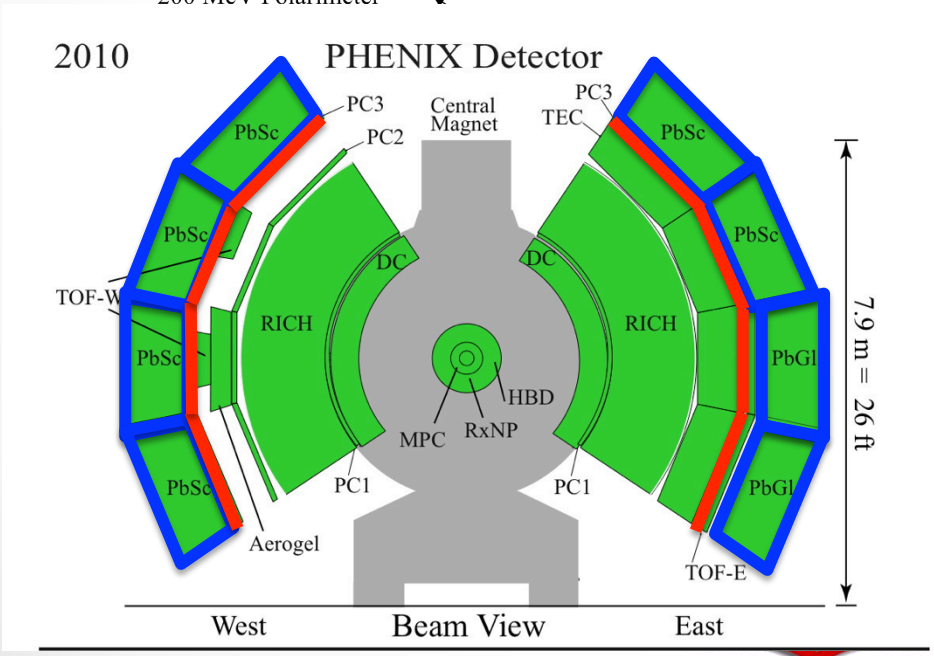
From e^+e^- (& SIDIS,pp)

Roughly, we have:

$$A_{LL} \cong a_{gg}\Delta g^2 + b_{gq}\Delta g\Delta q + c_{qq}\Delta q^2$$

RHIC and the PHENIX Detector





RHIC

- Polarized proton collider
  - Up to $\sqrt{s}$=510 GeV
  - P ~ 60% @ $\sqrt{s}$=200 GeV
  - Transverse or longitudinal polarization
  - Flip helicity combination every 106 ns

PHENIX: $\pi^0,\eta \rightarrow \gamma\gamma$

Electromagnetic Calorimeter:

- 6 sectors PbSc with 64 layers of Pb and scintillator
- 2 sectors PbGl
- $\Delta\eta \times \Delta\phi \approx 0.01 \times 0.01$

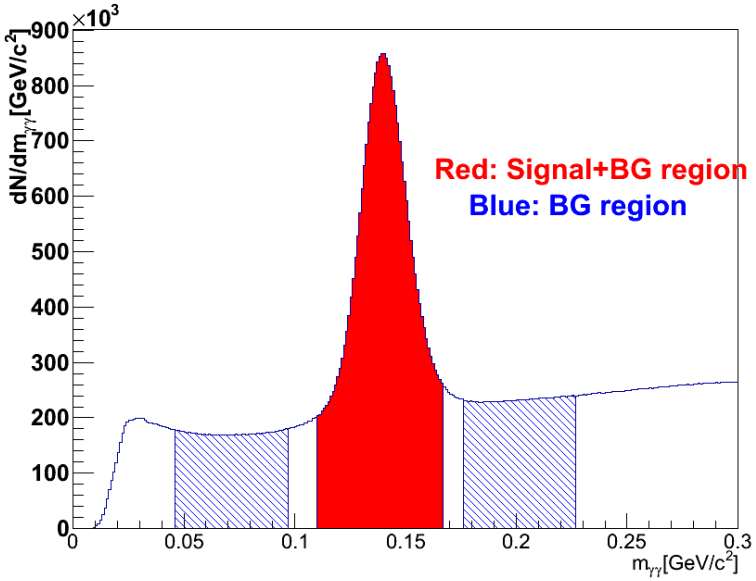
- Charged Particle Veto
  - Pad chambers directly in front of EMCal

Measuring A_{LL}

1. Calculate $A_{LL}(\pi^0+BG)$ and $A_{LL}(BG)$
2. Get Background ratio

$$r = \frac{N_{BG}}{N_{BG} + N_{\pi^0}}$$

3. Get A_{LL} using the following formula



$$A_{LL}{}^{\pi^0} = \frac{A_{LL}{}^{\pi^0+BG} - r A_{LL}{}^{BG}}{1 - r}$$

Where am I now??
Current Work

- Working on Run 13 p + p 510 GeV data analysis using Neutral Pion

Understanding the Nucleon is like: (Elephant and 6 Blind people)